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Bridging the Gap: Orchestrating Indonesian Higher Education

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Abstract

Objective: This study aims to ascertain the extent of the gap between the human resources presently available in the Republic of Indonesia (the number of study programs classified into fields of science existing in Indonesian higher education) and those required in the future to realize the *Visi Indonesia Emas 2045*. Furthermore, it seeks to identify how resource orchestration can narrow this gap through the lens of Resource Orchestration Theory (ROT).
Design/Methods/Approach: The study employs a qualitative research methodology utilizing secondary data sources, namely higher education statistical data issued by the Ministry of Education, Culture, Research and Technology, and gross domestic product industrial data issued by the Indonesian Central Statistics Agency.
Findings: This study finds a mismatch between the sector and study program by field of study both nationally and regionally. Nationally, some top sectors are not supported by specific study programs in accordance with their needs. Regionally, there is a mismatch between the distribution of study programs by field of study and the top industries in some region
Originality/Value: This research contributes to the existing body of literature on ROT by exploring its applicability to the country's human resources. While previous studies have employed ROT in organisational settings, this is one of the first to examine the theory in the country-level analysis. Furthermore, research on ROT has typically relied on surveys that are vulnerable to bias. This study, however, employs a distinctive and more comprehensive approach, namely the secondary data analysis.
Practical/Policy implication: It is imperative that higher education institutions adopt a resource orchestration theory, which entails discontinuing study programs that fail to reflect the current and future priorities of the industrial sector. This necessitates the establishment of future-oriented programs of study that are aligned with the evolving requirements of the industry and the development of curricula that equip human capital with the skills and knowledge that are required in the future.

Keywords: Resources orchestration, Higher education, Mismatch, Economic transformation

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1. Introduction

The global economy is rapidly moving towards being knowledge-based, where innovation and technology produce high-added value, leading to increased economic growth (Dalio, 2021). Knowledge is a key driver of economic growth (Barkhordari et al., 2018), particularly in developing countries, which have been slower to embrace the knowledge-based economy (e.g., Bano & Taylor, 2014). According to Zhu and Li (2016), a country's economic development is a structural transformation process involving its production capabilities, in which knowledgeable human capital plays the most important role ahead of other factors such as natural resources (Powell & Snellman, 2004). Of particular importance is the intellectual capital generated by universities, which has a positive relationship with the economic growth of a country or region (Tyndorf & Martin, 2018). As previously stated by Sukoco (2023), the role of human capital and higher education is important in contributing to the country's economic development, particularly in producing high-value-added products.

In this context, universities play a significant role in creating innovative research, thereby fostering competitiveness and contributing to the development of a country (Rottleb, 2022; Sum & Jessop, 2012; Abbas, 2024). This also applies to the extent of the implementation of knowledge-based economic development in Indonesia. According to the Global Innovation Index 2021, Indonesia's position in human resources and research that encourages innovation capabilities is concerning (Sukoco, 2022). Innovation capability requires human resource development direction, and higher education is the starting point (Sukoco, 2021). According to Lee (2019), economic growth at lower-income stages correlates with basic political institutions and human capital, while economic growth at higher-income stages correlates with innovation capabilities and higher education.

The concept of a knowledge-based economy implies an increase in knowledge-intensive industries and a rise in productivity, which in turn requires a greater number of highly skilled knowledge workers. (Powell & Snellman, 2004). These workers are mostly prepared by universities on various subjects offered by study programs based on market needs (Davis et al., 2006; Støren & Aamodt, 2010; Tomlinson, 2015). This has an impact on university leaders, who compete on the one hand to open study programs according to the wishes of parents and students (Grossi et al., 2019) that each graduate finds employment in the labor market (Støren & Aamodt, 2010) and on the other, that the university benefits from the student's personal financial contribution (Tomlinson, 2015).

However, this situation creates a potential mismatch between university graduates and the future requirements of the science and industrial sectors. In Indonesia, 2023 data from the Central Bureau of Statistics shows that 958,800 individuals, or 12% of all unemployed, held bachelor's degrees. In addition, among the top 10 most popular programs at the undergraduate level, only two programs were in science, technology, engineering, and mathematics (STEM) categories—namely computer science and civil engineering. The remaining eight programs are in the social sciences, with management and elementary school teacher education having the highest number of students, at 956,563 and 441,098, respectively. Furthermore, at the master's and doctoral levels, the most popular study programs were the Masters of Management and Masters of Law programs (Directorate General of Higher Education, 2020). Proficiency in the STEM sciences is closely related to the development of economic complexity in the construction industry (Lo Turco & Maggioni, 2022). Economic complexity determines a country's economic growth, i.e. the higher the knowledge applied in a country's production of goods and services, the greater the overall economic complexity of a country (Hausmann et al., 2014; Sukoco, 2023). In Indonesia, there is a mismatch between the supply of university graduates and the human resources required for Indonesia's future economic success, which is the focus of this study.

According to Alvarado et al. (2023), countries that are more dependent on natural resources and have low innovation face a particular risk that their economic growth will not be sustainable. To prevent this from occurring, efforts must be made to strengthen the role of universities in producing graduates who meet the needs of today and those required by economic complexity in the future. As explained by Sukoco (2023), education stakeholders need to provide a strategic direction that will be used in achieving goals in preparing human capital, whether focusing on meeting current market needs (market-driven) or directing the market to the products produced (market driving). The President of the Republic of Indonesia, Joko Widodo, has issued directives for universities to adapt their curricula to align with the demands of the industrial sector. This has resulted in the introduction of new programs of study including logistics management, retail management, and online stores in the faculty of economics, and social media studies in the faculty of social politics (Islami, 2017). According to Sukoco (2023), the preparation of human resources not only helps train human resources for existing industries and services in the country but also for future industries and services that will eventually be the economic locomotives for Indonesia. It is essential for higher education in Indonesia to align with the long-term needs of industries in order to become more competitive and also direct the market to the products produced (market driving). Universities need to play a role in meeting the changing and increasing demands for highly educated workers for jobs that implement future technological and skill changes (Goldin & Katz, 2007). With this theoretical lens in mind, our research question can be summarised as follows: "Is Indonesia's higher education provision in line with its human capital needs for the future?". Considering the aforementioned research problems, this research aims to ascertain the extent to which the existing human resource base is aligned with the requirements necessary for the realisation of the *Visi Indonesia Emas 2045*.

To answer the research question, first, we reviewed the resource orchestration theory and conceptualized how to orchestrate higher education study programs in Indonesia. Secondly, we explored secondary data released by various Indonesian ministries and institutions, such as the Central Bureau of Statistics and the Ministry of Education, Culture, Research and Technology. Thirdly, we analyze the data to examine the gap between the human capital provided by higher education and the human capital needed in the future, both nationally and regionally. Fourth, we provide recommendations on how to orchestrate human resources in the context of a discrepancy between current availability and anticipated future requirements. These suggestions are based on the tenets of Resource Orchestration Theory (ROT).

This study contributes to the body of knowledge by implementing the lens of resource orchestration theory (ROT) (Sirmon et al., 2010) in the context of country-level analysis primarily applied in organizational settings. As Sirmon explains, future studies should identify the locus of resource synchronisation at different levels of governance; this study applies the top-down managerial perspective common in organizations to the national level. As well the study complements several that have focused on the extent of the mismatch between graduates' and employers' needs and also the competence of university graduates to meet labor market demands in other countries, including Spain (Hernández-March et al., 2009), India (2016), and the Netherlands (Cabus & Somers, 2017). This study is in Indonesia, a developing country in the Group of Twenty (G20), a forum for world economies boasting high GDP and purchasing power parity (Klein & Salvatore, 2013).

Indonesia's large population will later be utilized to convert natural resources into products and goods or services with high added value. Additionally, Indonesia is renowned for its abundant natural resource wealth. However, the value of these natural resources can only be enhanced through the input of human resources. Therefore, the orchestration of human resources is essential to facilitate Indonesia's transition out of the middle-income trap and achieve *Visi Indonesia Emas 2045*. This study is designed to ascertain the nation's human resource capacity as the most significant factor influencing economic transformation. This is corroborated by Lee (2019) in his book entitled The Art of Economic Catch-Up, which posits that to become a developed country, two qualifications are prerequisites: quality and relevant tertiary education and human resources with innovation capabilities. Lee (2019) highlights the necessity for an in-depth examination of the current availability of human resources in Indonesia and the future needs of the country in order to achieve the vision set out in Visi Indonesia Emas 2045.

This research contributes not only to the theory but also to practical issues or policymakers. Reducing the mismatch between human capital availability and those needed in the future is in the hands of policymakers at the country and regional levels. The article is structured in the following format: introduction, literature review, methods, results and discussion, conclusions, implications (both academic and policy-related), limitations, and future research directions.

2. Literature Review

Resource Orchestration Theory

The ability to orchestrate resources is critical for organizational strategy, operations, and competitive industry dynamics (Sirmon et al., 2011). Managers must orchestrate organizational assets and configure capabilities to achieve competitive advantage to implement organizational and operational level strategies that generate positive outcomes. Change is necessary, however, as competitive environments are rarely static (Sirmon et al., 2010). Therefore, the knowledge of how organizations develop resource-based competitive advantages that enable them to compete successfully with their rivals is enhanced by a better understanding of how managers manage an organization's resource portfolio (Sirmon et al., 2011).

This paper uses the concept of resource orchestration as a theoretical lens to examine the competitive advantage of Indonesia as it seeks to transform into a developed country through its *Visi Indonesia Emas* 2045. The concept comes from the discipline of strategic management. However, it is relevant in canvassing potential solutions for Indonesia to become sustainably competitive when considering that a country is a more complex version of an organization. Managing a country requires a national leader capable of orchestrating a country's resources to create a competitive advantage. Resources that need to be orchestrated by national leaders include natural wealth, geographical areas, and human capital, with the latter being one of this study's most important and the focus.

Visi Indonesia Emas 2045, outlined in the National Long-Term Development Plan 2025–2045, underscores Indonesian human resources' pivotal role in driving national competitiveness. A growing body of empirical evidence (e.g. Magrizos et al., 2023; Jo & Chadwick, 2019) indicates that a country's advancement is largely contingent upon the quality of its human resources; higher education institutions are responsible for developing and providing these human resource capabilities.

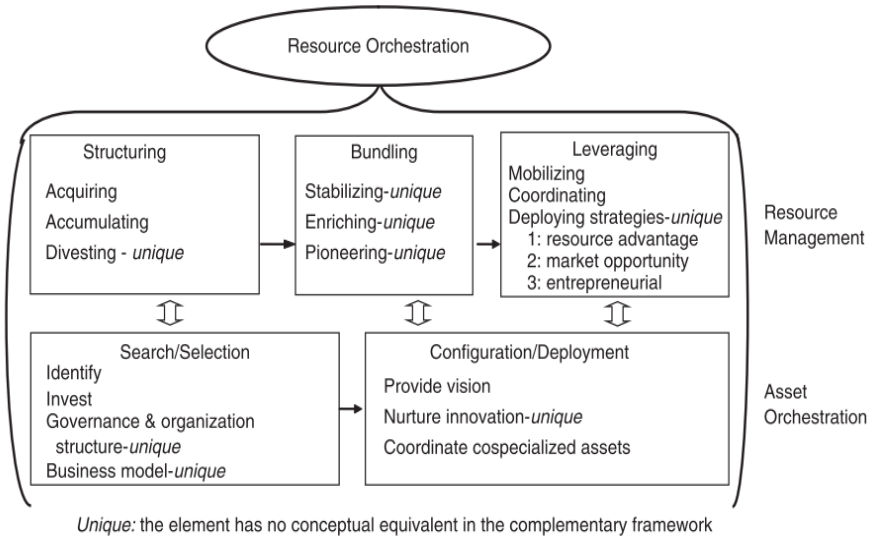

Figure 1. Resource Management and Asset Orchestration Frameworks (Sirmon et al. 2011)

The integrated framework presented in Figure 1 extends our understanding of resource-based theory (RBT) and forms a basis for future RBT-related research. This study will use this framework as a guideline for orchestrating human capital in order to meet *Visi Indonesia Emas* 2045. A limited but expanding body of literature derived from RBT and dynamic capabilities has emerged to examine how leaders deploy their resources (Sirmon et al., 2011).

The resource management framework proposed by Sirmon et al. (2011) explicitly addresses the process-oriented managerial actions involved in achieving competitive advantage and creating value. According to the framework, resource management encompasses three core elements: (i) the structuring of the resource portfolio, including acquiring, accumulating, and divesting; (ii) bundling resources, which is the building of capabilities through stabilising, enriching, and pioneering activities; and (iii) leveraging capabilities in the marketplace, or the deployment of resources through the mobilisation, coordination, and deployment of activities. These three elements collectively represent value creation (Sirmon et al., 2011).

The structuring process involves acquiring, accumulating, and divesting resources to form the country's resource portfolio. Acquiring refers to purchasing resources from the markets while accumulating refers to developing resources internally, and divesting refers to the controlled disposal of resources (e.g., layoffs, sales, and spin-offs) (Carnes et al., 2017; Sirmon et al., 2011).

Bundling, which refers to the integration of resources into capabilities, has three sub-processes: (i) stabilization or small incremental improvements to existing capabilities; (ii) enriching to extend existing capability; and (3) pioneering, or creating new capability (Carton & Parigot, 2024; Sirmon et al., 2011).

Leveraging involves a series of processes designed to form requisite capability configurations and deploy to exploit capabilities. It includes (i) mobilizing, which provides a plan or vision for the capabilities required to form the necessary configurations of capabilities; (ii) coordinating, which includes the integration of the configurations of capabilities; and (iii) deploying, in which the configurations of capabilities formed by the coordinating sub-process are used to exploit a resource advantage, market opportunity, or business strategy (Attah-Boakye et al., 2023; Wendt et al., 2022; Sirmon et al., 2011).

Resource orchestration involves strategies and actions employed to achieve national goals. Thus, the question arises as to whether a nation's strategy will be focused on producing products that can meet current market needs (market-driven) or directing the market to the products produced (market-driven). In the context of higher education, resource orchestration can be expressed as a choice between educating graduates who are needed or perceived to be needed by society today or graduates for the future.

It may be beneficial to examine examples of other countries that have adopted the concept of resource orchestration to exit the middle-income trap, including China, Vietnam, and Singapore. One can observe China's success in increasing the complexity of its economy by increasing the size of its knowledge-based economy. China's position in the global economy has risen from 39th to 17th largest, and its GDP per capita has grown 12-fold over the past two decades. Nevertheless, there is a growing trend whereby Chinese companies dominate the digital market, health equipment, and even sustainable technologies. The 2017 China Statistical Yearbook indicated that three million students enrolled in STEM programs.

In order to secure its leadership in the technology sector, the Made in China 2025 program was launched in 2015. The program encompasses 10 strategic industries intended to transform the economy from low-cost to high-added value. Given that these 10 strategic industries are expected to contribute approximately 40% of China's

manufacturing industry, all resources and regulations are directed toward supporting the achievement of the nation's goals. This includes the technical and vocational education and training (TVET) institutions that offer programs in these strategic industries and the research that they produce. The technology is developed by scientists through scientific research and patented. Patents are then employed by industrial enterprises (businesses) to facilitate the production of technologically sophisticated and high-value products. The government establishes the direction and provides the budget, scientists conduct research into the technology, and business people implement it. China's electric car industry has secured a global market share of over 80% due to government incentives and subsidies, as well as patents derived from scientific research.

Vietnam also engages in resource orchestration. In recent years, Vietnam has been the subject of considerable discussion in international media and academic journals concerning the high quality of its human resources. Indeed, it has been suggested that the country outperforms developed countries such as the United States, Canada, and the United Kingdom. The Vietnamese government has allocated a budget for developing the country's education system. The Vietnamese government requires that each local government allocate a budget amounting to 20% of its total budget to education. The curriculum is based on the Chinese national curriculum framework, and teaching standards are updated regularly. Demonstrating the importance the Vietnamese place on education, the policy is rigorously enforced, particularly in instances where schools are performing poorly and are consequently downgraded, which impedes their ability to attract students.

Lastly, Singapore 's strong commitment of the government and society to quality education has positioned Singapore as a global knowledge leader. The educational arms race (Gee, 2012) is a fundamental policy that states that investment in education will improve the well-being of society as a whole. A policy to recruit only the best and brightest to teach by offering a decent salary and a respectable status in society means that teaching is a dream for Singapore's top talent, and there is a national obsession to excel and get high grades, especially in STEM fields.

Looking at these countries, how can other developed countries emulate them to escape their middle-income trap? They utilise resource orchestration, with the primary objective of developing human resources capable of producing high-value added products.

3. Method

To answer the research questions, the authors applied qualitative research with a secondary data approach (Dawadi, 2021). The data was gathered by collecting various types of secondary data sources in the form of Higher Education Statistics (2020). Data issued by the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia as data on the availability of human resources in Indonesia and data from the Indonesian Central Statistics Agency (2020) regarding the distribution of the highest GDP from industries in Indonesia which describes the need for human resources in Indonesia as a support main *Visi Indonesia Emas 2045*. Furthermore, the gathered data and information were subsequently verified and classified as the foundation of analysis to answer the existing research questions (Sandelowski, 2001).

4. Result and Discussion

4.1 The Core Foundation of Indonesia Emas 2045: Human resources

Human resource development forms the foundation of successful economic transformation. High-quality human resources will utilize creativity, innovation, and strong work ethics, forming a foundation to accelerate national development agendas (Whyte, 1956). In other words, excellent human resource capacity is a prerequisite for countries to successfully transform their economies from low or middle-income to high-income categories. With substantial human resource capacity, states can create economic transformation more feasibly (McMillan et al., 2017), such by: (i) implementing structural changes to move workers and resources from low productivity to high productivity; (ii) optimizing economic growth based on strategic and priority sectors through knowledge-based technology; (iii) supporting priorities and applicable regions as locomotives of economic growth.

Remarkable examples of transforming economies such as Japan, South Korea, and China paid great attention to improving their educational systems and research and development, which served as both a crucial and great investment in their respective long-term national development agendas. These success stories suggest that Indonesia needs to take huge leaps and transformative measures to successfully escape from decades stuck in the middle-income trap.

Visi Indonesia Emas 2045 lays out Indonesia's aim to be a developed country by 2045, and higher education will play an important role in shaping the nation's human capital required to achieve this. As providers of human resources, higher education institutions must adapt their curricula to meet the needs of the future workforce. Humans are a country's most important resource. With a large young population—65% of the population was aged under 40 years according to the 2020 Population Census—and the seventh largest market size in the world, Indonesia has promising basic capital but needs the right direction for its human resource development, with higher education the starting point. How can higher education be orchestrated to produce superior human resources as *Visi Indonesia Emas* 2045 requires?

The Higher Education Statistics (2019) report reveals that Indonesia has 4,621 higher education institutions. High

schools number the highest, at 2,501, while there are 909 academies and 633 universities. Some 28,879 study programs are operational, with universities offering the largest number of them, at 15,502. In terms of the subjects covered by the study program, management study has the highest, at 1,140 study programs, followed by accounting, midwifery, Islamic religious education, informatics engineering, nursing, civil engineering, information systems, and pharmacy.

A statistical analysis of the 2020 Higher Education Statistics shows that Indonesia offered 29,413 different study programs. Academic-based programs continued to constitute most of these offerings, representing 88.33% (25,987 units) of all available programs. Education remained the field with the greatest number of available programs (6,032 units), followed by engineering, social sciences, healthcare, and economics. The field of educational sciences boasted the greatest number of newly enrolled students (435,986 individuals), followed by economics, social, technical, health, and other disciplines within the sciences. Examining whether these study programs will help meet Indonesia's current and future human resource needs is important. Education is a long-term investment, and the effective management of resources is crucial for strengthening Indonesia's position in the global market. The identification of suitable existing study programs and the development of future-oriented ones, along with the potential closure of those that are less relevant, are essential to building a robust education system.

It is not necessarily the case that what is popular now will be required of graduates in the future. Therefore, it is essential to provide a long-term vision for education, particularly to support the achievement of *Visi Indonesia Emas* 2045. This must be done without abandoning national values. The strategic industries that will be Indonesia's advantages in the future can be used as a reference. Furthermore, long-term funding commitments will provide certainty and sustainability of the nation's competitiveness in the future.

It is important that the nation's future needs are reflected in the integration of study programs in higher education. Autonomous higher education institutions (AHEIs) must facilitate establishing future-oriented study programs through pilot projects. Programs that are no longer relevant to the country's needs must be discontinued. To support this, upgrading and retraining lecturers is a necessity. This orchestration must be consistent and continuous.

Indonesian Higher Education Statistics Data for 2020 (Ministry of Education, Culture, Research and Technology of the Republic of Indonesia, 2022) shows the availability of human resources that will support Indonesia's human resources needs in the future to welcome a *Indonesia Emas* 2045. Meanwhile, GDP distribution data released by the Central Statistics Agency (2020) describes the needs of Indonesian industry in the future (Tables 2 and 3).

4.2. Indonesia's Human Development Index: Middle-Rank

One common key to successful economic transformation is the quality of a nation's human resources. Indonesia's human capital quality is below the global average and remains lower than that of higher middle-income countries. This is represented in the Human Development Index (HDI) Data shown in Table 1. Indonesia's 2020 ranking of 107 out of 189 countries in the HDI formulated by the United Nations Development Program (UNDP) is considered low. Although the country's rank has improved, it remains in the middle ranking globally and is below the average for higher middle-income countries. Compared to neighboring countries in Southeast Asia, Indonesia ranks fifth, behind Singapore, Brunei Darussalam, Malaysia, and Thailand. Indonesia's HDI is still far from the goal of being a developed country to achieve the *Visi Indonesia Emas 2045*.

Indonesia must make quick and comprehensive improvements to improve its ranking while also reorienting its national development strategy to realize *Visi Indonesia Emas* 2045. Several targets for improving the quality of human resource development to meet this vision can be identified using the perspective of resource management and asset orchestration frameworks (Sirmon et al. 2011). First, study programs provided by universities in Indonesia must be aligned with needs. Second, the gross participation rate of higher education must reach 60 percent by 2045. Third, the proportion of professional graduates in the field of STEM must be increased. Fourth, research and development spending must be increased from the current 0.28 percent to around 1.5–2.0 percent of GDP by 2045.

The success or failure of these goals will be highly dependent on several factors. First, strong commitment and political will is required of Indonesia's transformational leaders. In this context, transformational leadership is defined as leadership that inspires, stimulates, and moves followers to achieve or even exceed development targets. Transformational leaders must be capable of prioritizing the state's educational reform by creating a visionary yet feasible roadmap, including effective regulation, sufficient political and financial support, as well as other bureaucratic and technocratic elements. As of 2024, Indonesia's expenditure per capita on education is quite low at US$124.17, equivalent to 33.38 percent of China's, 23.99 percent of Malaysia's, and 7.19 percent of Singapore's (Sukoco, 2022). To increase expenditure on education, Indonesia needs stronger political will and commitment from the top leadership at all levels of government.

Table 1. Human Development Index Data (UNDP, 2020)

Country	Ranking	HDI Value	Life Expectancy at Birth	Expected Years of Schooling	Mean Years of Schooling	GNI per Capita (Atlas Method US$)
Singapore	11	0.938	83.6	16.4	11.6	64,010
Brunei Darussalam	47	0.838	75.9	14.3	9.1	31,510
Malaysia	62	0.810	76.2	13.7	10.4	10,930
Thailand	79	0.777	77.2	15.0	7.9	7,260
Indonesia	**107**	**0.718**	**71.7**	**13.6**	**8.2**	**4,140**
Philippines	107	0.718	71.2	13.1	9.4	3,640
Vietnam	117	0.704	75.4	12.7	8.3	3,560
Laos	137	0.613	67.9	11.0	5.3	2,520
Cambodia	144	0.594	69.8	11.5	5.0	1,550
Myanmar	147	0.583	67.1	10.7	5.0	1,140

GNI = Gross National Income, HDI = Human Development Index
Source : Human Development Report Office (UNDP, 2020 ;World Bank Data, 2022)

The second factor is the capacity of transformational leaders to orchestrate the nation's human resources to match the top strategic priority sectors (Sirmon, 2011). To determine these strategic priority sectors, Indonesia must first be able to categorize and evaluate all its comparative and competitive advantages, which may become the core strength of its future economy. Once determined, human resource orchestration can be carried out through educational reform by strengthening the access to and quality of vocational schools and universities. Such orchestration would not only increase the quantity and quality of the formal educational participation rate. However, it would also allow job creation, workforce absorption, and increased productivity, which ultimately leads to higher economic growth and per capita income.

4.3. Indonesia's Human Resources Availability vs Future Needs: Mismatch

The development of human capital through higher education is a real contributor to economic development, with many examples of how this has worked, such as the export of services by Australia, the economic development of Western Europe and the United States, and, in the last two decades, South Korea and China, all supported by world-class universities (Sukoco, 2022). Developed countries encourage their universities to be locomotives of economic development by boosting their innovation capabilities to allow them to produce patents. For instance, South Korea and Taiwan in 2000 produced more than 5,000 US patents, while middle-income countries had fewer than 500 applications (Lee, 2016). Florida and Mellander (2015) argue that world-class universities will attract the best talent, apply the latest technology, and have a high tolerance for differences, allowing innovation and high-value-added economies to flourish. The high value-added economic transformation initiated by world-class universities is driven by the presence of the best talent and the latest technology (Sukoco, 2024). In addition, lacking innovation in most tertiary institutions has led to a significant mismatch between education and industry needs. Tertiary institutions are not prepared for the rapidly changing demands of the labor market, which affects economic growth and industrial development. This requires the orchestration of resources to be considered a continuous process of accessing, integrating, developing, and releasing resources (Schriber & Löwstedt, 2018). The government can plan interventions on asset coverage of universities based on the dynamism of external and internal factors of higher education, such as merging universities to be more competitive.

In Tables 2 and 3, the industrial sector's demands and the education sector's supply are compared. The Processing Industry contributes the highest percentage to GDP, while the highest number of fields of study related to program study is Education—a clear mismatch. In addition, sectors such as agriculture, mining and excavation, construction, and transportation require more attention to be supported through study programs relevant to these sectors. The following sub-chapter will present a detailed examination of the discrepancies observed at the national and regional levels. The analysis will draw upon data obtained from two sources: the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia (2020) and the Indonesian Central Statistics Agency (2020).

4.3.1 Mismatch at the National Level

Table 2 presents data pertaining to the interrelationships between sectors and study programs, with a particular focus on the field of study. A comparison of each sector and study programs based on the field of study, for instance, the processing sector with study programs based on the field of study in education, reveals that the processing sector is the largest contributor to GDP at 19.87%. In contrast, the study programs in education amount to 6,032, which is a significant discrepancy. This indicates that the study programs in education are not as relevant to the processing sector as they could be. The term 'processing' encompasses activities that alter a basic item through mechanical, chemical, or manual means, transforming it into a finished or semi-finished product or increasing its value. These activities are often conducted closer to the end user (BPS, 2020) and require a specific skill set. The majority of workers in this sector oversee the production process and are typically required to have a background in engineering or science. Therefore, the study programs that would be most beneficial for this sector would be those related to industrial engineering, agro-industrial technology, chemical engineering, food science, mechanical engineering, electrical engineering, biotechnology, and other similar programs in science and technology.

Secondly, the agriculture, forestry, and fisheries sectors represent the second largest contributor to Indonesia's gross domestic product (GDP), accounting for 13.7% of the total. This sector encompasses a range of activities, including food crop farming, plantations, horticulture, livestock, forest product harvesting, and fish and aquatic biota catching and cultivation (BPS, 2020). This sector requires graduates with a background in agricultural, forestry, and fisheries-related knowledge. The study programs required generally originate from the faculties of agriculture, forestry, and fisheries, including those in food and agricultural product technology, agro-industrial technology, forestry, aquaculture, and fisheries product technology, as well as other related disciplines. A comparison between the agriculture, forestry, and fisheries sectors and study programs in the field of science reveals that the latter is still too general and lacks sufficient specificity concerning the aforementioned sectors.

The third sector comprises wholesale and retail trade and the repair of motor vehicles and motorcycles, which collectively contributed 13.7% to the economy. This sector encompasses economic activities related to the wholesale and retail trade of various types of goods and the provision of services in connection with the sale of these goods. These activities include wholesale trade and final retail trade in the distribution of goods and the repair of motor vehicles and motorcycles (BPS, 2020). This sector is of greater relevance to those who have obtained a degree in economics, as they possess a more nuanced understanding of key economic concepts such as supply and demand, pricing strategies, consumer behavior, inventory management, and marketing and business strategies. Consequently, the requisite courses in this sector are those pertaining to management and business studies, business administration, and accounting, among others. Additionally, this sector requires graduates with a comprehensive understanding of the maintenance and repair of motor vehicle engines. Consequently, the principal areas of study are mechanical engineering, automotive engineering, electrical engineering, mechatronics, and other related disciplines. A comparison between the fields of wholesale and retail trade, repair of motor vehicles and motorcycles, and social sciences reveals that the latter is not a suitable study area. This is because social sciences encompass a range of disciplines, including political science and sociology. The aforementioned disciplines, namely demography, anthropology, psychology, and geography (UNESCO Institute for Statistics, 2012), exhibit a paucity of relevance to the competencies required for success in the field of wholesale and retail trade and repair of motor vehicles and motorcycles.

Fourth, the construction sector encompasses physical infrastructure development, including buildings, roads, bridges, and other public facilities. It also includes repairing and maintaining buildings and other infrastructure projects (BPS-Statistics Indonesia, 2021b). Generally, the sector requires graduates with engineering and analytical skills in construction, such as the design, construction, and maintenance of infrastructure such as roads, bridges, and buildings. Therefore, The programs that this sector requires are mainly civil engineering, architecture, construction management, geodesy, and other related programs. A comparison between the construction sector and study programs based on the field of health demonstrates that this is an inappropriate analogy. The fifth sector is mining and excavation, which is concerned with the extraction of natural resources in the form of solid minerals (such as coal and metal ores), liquid (petroleum), or gas (natural gas) (BPS-Statistics Indonesia, 2016). The competencies that individuals employed in this sector should possess are related to various aspects of the exploration, processing, and management of natural resources, particularly those associated with mining. The findings of this analysis indicate that the academic programs aligned with this sector are primarily within the field of economics, including business management, accounting, and economics. This observation highlights discrepancies between the sector's requirements and the scientific-based programs offered. The sixth sector is that of the information and communication industry. This encompasses the production and distribution of information and cultural products, the provision of facilities for the sending or distributing these products, data or communication activities, information technology and data processing, and other information service activities (BKPM, 2021). Programs of study related to this sector should be related to information and computer technology, telecommunications engineering, electrical engineering, design and multimedia, and others. The study findings indicate that the study programs related to this sector are those pertaining to agriculture. This observation further highlights the discrepancy between the sector and its corresponding study programs.

Seventh, the financial services and insurance sector encompasses a range of financial activities, including insurance, reinsurance, pension fund activities, and financial support services (BPS, 2020). This sector is related to several different

banking, investment, insurance, and risk management services, which are generally related to the fields of financial management, investment, financial and insurance risk management, actuarial science, and others. Consequently, graduates who are more suited to this sector have studied in programs in business and economics, for example, accounting, financial management, actuarial science, economics, business and administration, and others. Conversely, study programs in the field of religious science are less suited to this sector.

The eighth sector is that of transportation and warehousing. This sector encompasses activities related to the transportation of goods and passengers, as well as the storage of goods. These activities may occur via land, sea, air, or pipeline transportation (BPS-Statistics Indonesia, 2021a). The study programs most suitable for the transportation and warehousing industry are those in transportation planning and engineering, logistics management, supply chain management, industrial engineering, and others. It can be concluded that study programs in the field of agriculture are not particularly suited to this sector. The study results indicate that study programs in science, specifically mathematics and natural sciences, are more aligned with the sector's requirements. These fields are classified as basic sciences, which generally provide a fundamental understanding of nature and the laws that govern it, without directly considering its implementation.

The ninth sector comprises government administration, defense, and mandatory social security. This sector is concerned with government activities typically conducted by government administration (BKPM, 2021). Activities within this sector are primarily concerned with the government's responsibility for the provision of efficient services, security, and social welfare for the community. Those pursuing a career in this sector may wish to consider undertaking a course of study in one of the following disciplines: government, law, public administration, social welfare, public sector finance, and other related fields of study. Conversely, the study's findings indicate that academic programs focusing on the sciences that align with the government administration, defense, and mandatory social security sector are those within the humanities. The field of humanities encompasses a range of disciplines, including literature, archaeology, history, philosophy, and others (UNESCO Institute for Statistics, 2012). The focus on fields of science differs between study programs in the field of humanities and those in other sectors. Thus, the aforementioned study programs do not align with the requisite field of science for the government administration, defense, and mandatory social security sector.

Table 2. Top 10 Sector Industries and Top 10 Study Programs based on Field of Study

No	Sector	Distribution of GDP	No	Study Programs based on the Field of Study	Amount	%	STEM/Non-STEM
1.	Processing	19.87%	1.	Education	6.032	21%	Non-STEM
2.	Agriculture, forestry, and fisheries	13.7%	2.	Engineering	5.390	18%	STEM
3.	Wholesale and retail trade; car and motorcycle repair	12.91%	3.	Social	4.302	15%	Non-STEM
4.	Construction	10.7%	4.	Health	4.034	14%	STEM
5.	Mining and excavation	6.43%	5.	Economics	3.599	12%	Non-STEM
6.	Information and communication	4.51%	6.	Agriculture	1.988	7%	STEM
7.	Financial services and insurance	4.51%	7.	Religion	1.692	6%	Non-STEM
8.	Transportation and warehousing	4.47%	8.	Mathematics and natural sciences	1.219	4%	STEM
9.	Government administration, defense and mandatory social security	3.79%	9.	Humanities	731	2%	Non-STEM
10.	Education services	3.57%	10.	Arts	426	1%	Non-STEM

Source: Higher Education Statistics (2020), Ministry of Research, Technology and Higher Education of the Republic of Indonesia, and Indonesian Central Statistics Agency (2020)

The tenth sector is that of education services. This encompasses the full range of educational activities at all levels and for all occupations, delivered verbally and in writing as well as through various communication channels. The sector includes early childhood education, basic education, secondary education, higher education, and other forms of education (BPS, 2020). The education sector encompasses a multitude of roles across a diverse array of scientific fields, including educators, administrative staff, librarians, and other personnel. The Education Sector requires relevant resources, especially for educators, teachers, and lecturers with a STEM background, in order to increase the number of graduates with a STEM background. This is mainly to improve the nation's innovation capabilities in the future (Sukoco, 2021). Based on the aforementioned explanation, it can be seen that there is a significant mismatch between the majority of sectors and each study program based on the field of study.

4.3.2 Mismatch at the Regional Level

Table 3 presents a descriptive comparison of sectors in the province, focusing on the availability of study programs aligned with the field of study in the province and the LLDikti region. This analysis considers the proximity of study programs in each LLDikti region, acknowledging the potential for more convenient access to educational opportunities in nearby locations. The highest contributor to gross regional domestic product (GRDP) in Sumatera Utara Province is the agriculture, forestry, and fisheries sector. The engineering study program is the most widely available in the province. The study program in question has a sufficient availability rate in this province since the processing sector represents the second largest contributor to GRDP in the province. Other relevant study programs include economics, with the Wholesale and Retail Trade and Car and Motorbike Repair sectors. It is notable that the number of programs in the education and health sectors in Sumatera Utara Province is relatively high, yet their relevance to the sectors in question is limited.

In the LLDikti Region II, the processing sector is the largest contributor to GRDP in Sumatra Selatan. This is supported by the engineering study program, which is the study program with the largest number, namely 567 study programs in LLDikti Region 2. However, the provinces of Lampung, Kepulauan Bangka Belitung, and Bengkulu exhibit disparate characteristics, with the largest contributors to GRDP being agriculture, forestry, and fisheries. The sector is not adequately supported by the requisite study programs. The number of programs related to agriculture (221) is less than that of other programs, such as health science (398), education (390), and economics (359). In the province of DKI Jakarta (LLDikti III), the largest contributor to GRDP is the Wholesale and Retail Trade sector, followed by the Processing sector and Construction. The largest study programs in DKI Jakarta are engineering and economics. The aforementioned study programs are pertinent to the sectors that contribute to GRDP. In LLDikti Region IV, which encompasses the provinces of West Java and Banten, the largest contributor to GRDP in both provinces is processing and wholesale and retail trade, car and motorbike repair. This is reflected in the availability of study programs related to engineering (1788) and economics (1079). A number of other provinces in Java, including DI Yogyakarta (LLDikti Region V), Jawa Tengah (LLDikti Region VI), and Jawa Timur (LLDikti Region VII), have the highest contributing sector, namely processing. This sector is also supported by the availability of study programs related to engineering, which represents the largest study program in the three provinces. Nevertheless, the prevalence of study programs in the fields of health, education, and social science is still considerable. This is not aligned with the relevance of these subjects to the agriculture, forestry and fisheries sector, which also makes a significant contribution in the three provinces.

Moreover, in LLDikti VIII, which encompasses the Provinces of Bali and Nusa Tenggara Barat, the primary contributors in Bali Province are the provision of accommodation and food and drink, as well as agriculture, forestry, and fisheries. However, the study programs with the highest enrolment in Bali Province are not sufficiently aligned with the needs of these sectors. This is because the most popular study programs in the LLDikti VIII region are engineering and education. Similarly, in Nusa Tenggara Barat Province, the sectors that contribute the most are Agriculture, Forestry, Fisheries, Mining, and Excavation. However, this is not reflected in the availability of sufficient Study Programs, as the largest study programs in LLDikti VIII are Engineering and Education. Furthermore, in LLDikti IX, which encompasses Sulawesi Selatan, Sulawesi Tenggara, and Sulawesi Barat, the three provinces with the highest contributing sectors are agriculture, forestry, and fisheries. However, the largest study programs in these three provinces are engineering, in addition to health (671), education (527), economics (416), and social science (405) programs, which are more dominant than agriculture programs (368). LLDikti X encompasses the provinces of Sumatera Barat, Jambi, Riau, and the Kepulauan Riau. In the provinces of Sumatera Barat and Jambi, it is evident that the primary contributor is the agriculture, forestry, and fisheries sector. However, the availability of study programs in the largest LLDikti X region is dominated by engineering, health, and education. This indicates that the provision of agriculture study programs (235) is insufficient compared to other academic offerings. In the provinces of Riau and Kepulauan Riau, the processing industry is the primary contributor to the regional gross domestic product (GDP). This sector aligns with the availability of engineering programs in the LLDikti X region.

LLDikti XI encompasses the provinces of Kalimantan Selatan, Kalimantan Timur, Kalimantan Utara, Kalimantan Barat, and Kalimantan Tengah. In the provinces of Kalimantan Selatan, Kalimantan Timur, and Kalimantan Utara, the sector that contributes the most is mining and excavation. The most popular study programs in LLDikti XI are engineering, health, and education. In the provinces of West Kalimantan and Kalimantan Tengah, the highest gross

regional domestic product (GRDP) is in the agriculture, forestry, and fisheries sectors. There are 235 study programmes related to agriculture in LLDikti XI. The following section presents an analysis of the provinces of Maluku and Maluku Utara, which are included in LLDikti XII. In both provinces, the largest contributors to GRDP are agriculture, forestry, and fisheries. This is reflected in the ranking of study programs, with agriculture coming in as the second largest after education, which is ranked first. Moreover, in Aceh Province (LLDikti XIII), where the primary contributor to GRDP is Agriculture, Forestry, and Fisheries, and the most prevalent study programmes in Aceh Province are in the field of Education. The number of study programs related to agriculture is comparatively limited, given the prevailing focus on other disciplines that are not directly relevant to the sector. In LLDIkti XIV, which covers the Provinces of Papua and Papua Barat, it is evident that the Mining and Excavation sector contributes the most to GRDP in Papua Province. However, despite the sector's significance, support for its growth remains constrained. While the number of engineering programs is the highest, not all engineering programs are aligned with the specific needs of the Mining and Excavation sector. It can be observed that engineering study programs are more relevant to the province of Papua Barat, which has the processing sector as the highest contributing sector in this province. Moreover, in Nusa Tenggara Timur, the Agriculture, Forestry, and Fisheries sector is the primary contributor to GRDP. However, the majority of study programs are in the field of education. This particular study program is not as relevant to the province's primary sector. The province of Nusa Tenggara Timur has 123 agriculture study programs to support its Agriculture, Forestry, and Fisheries sectors. Furthermore, in LLDIkti XVI, the provinces of Gorontalo and Sulawesi Utara are included, where the most significant sectors are agriculture, forestry, and fisheries. This sector can be supported by 164 agriculture study programs. Compared to other study programs such as engineering, education, and social science in LLDikti XVI, the number of agriculture study programs is smaller. However, this is not the case in the province of Sulawesi Tengah, where the processing sector is the primary contributor to PDRB. Consequently, the availability of engineering study programs in LLDikti XVI is a pertinent consideration.

In light of the explanation above, it is evident that the sectors contributing to GRDP in numerous provinces are of significant relevance to the study programs in question. As evidenced by the case of the provinces on Kepulauan Jawa, namely DI Yogyakarta, Jawa Tengah, Jawa Timur, Jawa Barat, and Banten, the processing sector represents the largest contributor to GRDP. A considerable number of engineering study programs support this. Nevertheless, in several provinces, it has been observed that a considerable number of study programs, such as those related to education and health, have a relatively high representation. At the same time, those in the field of science are less relevant to their respective sectors. This indicates a persisting mismatch between the economic sector and its study programs. A similar situation can be observed in several other provinces, including Lampung, Kepulauan Bangka Belitung and Bengkulu, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat, Sumatera Barat, Jambi, Aceh, and Nusa Tenggara Timur. In these regions, the dominant sectors are agriculture, forestry, and fisheries, yet the number of study programs related to these sectors is relatively limited. Similarly, the province of Bali exhibits a dearth of study programs aligned with the accommodation, food and drink, and agriculture, forestry, and fisheries sectors. This underscores the pervasive mismatch between economic sectors and their corresponding study programs across most provinces. Table 3 shows that most provinces have agriculture, forestry, and fisheries sectors as their top contributing sectors to gross regional domestic product (GRDP). However, STEM is still far from the most popular field of study.

Table 3. Higher Education Study Programs and Sectors Contributing to Highest GRDP in Each Province in Indonesia

Region	Province	Public or Private Higher Ed	Number of Study Program based on Field of Study											Top 3 Sector Industries contributing most to GRDP (Gross Regional Domestic Product)
			STEM				Non-STEM							
			Health science	Mathematics and Natural Sciences	Agriculture	Engineering	Religion Studies	Economics	Humanities	Education	Art	Social science	Total of Study Program	
LLDikti Region I	Sumatera Utara	Private	494	72	168	564	42	372	40	412	12	228	2.404	• **Sumatera Utara**: Agriculture, forestry, and fisheries; Processing; Wholesale and retail trade, car and motorbike repair.
		Public	42	26	12	52	2	27	21	53	3	31	269	
Subtotal			536	98	180	616	44	399	61	465	15	259	2673	
LLDikti Region II	Sumatera Selatan, Lampung, Kepulauan Bangka Belitung, Bengkulu	Private	364	48	132	492	22	316	28	312	12	226	1952	• **Sumatera Selatan**: Processing; Mining and excavation; Agriculture, forestry, and fisheries • **Lampung, Kepulauan Bangka Belitung:** Agriculture, forestry, and fisheries; Processing; Wholesale and retail trade • **Bengkulu :** Agriculture, forestry, and fisheries; wholesale and retail trade; Government administration and others
		Public	34	43	89	75	4	43	6	78	2	59	433	
Subtotal			398	91	221	567	26	359	34	390	14	285	2385	
LLDikti Region III	DKI Jakarta	Private	508	116	70	1048	82	812	106	240	166	732	3880	• **DKI Jakarta** : Wholesale and retail trade; car and motorbike repair; Processing; Construction
		Public	120	27	1	93	8	46	40	70	20	80	505	
Subtotal			628	143	71	1141	90	858	146	310	186	812	4385	
LLDikti Region IV	Jawa Barat, Banten	Private	774	220	172	1560	76	994	130	682	116	742	5466	• **Jawa Barat :** Processing; Wholesale and retail trade, car and motorbike repair; Agriculture, forestry, and fisheries • **Banten**: Processing; Wholesale and retail trade, car and motorbike repair; Construction
		Public	80	79	168	228	11	85	34	177	24	106	992	
Subtotal			854	299	340	1788	87	1079	164	859	140	848	6458	
LLDikti Region V	DI Yogyakarta	Private	240	84	70	366	38	240	34	188	16	214	1490	• **DI Yogyakarta**: Processing; Agriculture, forestry, and fisheries; Information and communication
		Public	61	31	50	100	5	35	36	95	33	67	513	
Subtotal			301	115	120	466	43	275	70	283	49	281	2003	
LLDikti Region VI	Jawa Tengah	Private	668	184	126	798	50	552	46	462	56	356	3298	• **Jawa Tengah**: Processing; Agriculture, forestry, and fisheries; Wholesale and retail trade, car and motorbike repair
		Public	78	41	62	120	5	54	36	129	23	74	622	
Subtotal			746	225	188	918	55	606	82	591	79	430	3920	
LLDikti Region VII	Jawa Timur	Private	858	186	282	970	92	720	64	894	60	564	4690	• **Jawa Timur**: Processing; Wholesale and retail trade, car and motorbike repair; Agriculture, forestry, and fisheries
		Public	143	80	97	286	13	105	38	173	27	110	1072	
Subtotal			1001	266	379	1256	105	825	102	1067	87	674	5762	
LLDikti Region VIII	Bali, NTB	Private	232	60	100	238	32	160	38	300	24	222	1406	• **Bali**: Provision of accommodation and food and drink; Agriculture, forestry, and fisheries; Construction • **NTB:** Agriculture, forestry, and fisheries; Mining and excavation; Wholesale and retail trade
		Public	43	21	40	208	2	134	16	67	17	46	594	
Subtotal			275	81	140	446	34	294	54	367	41	268	2000	
LLDikti Region IX	Sulawesi Selatan, Sulawesi Tenggara, Sulewesi Barat	Private	596	112	272	506	26	366	36	418	2	340	2674	• **Sulawesi Selatan :** Agriculture, forestry, and fisheries; Wholesale and retail trade, car and motorbike repair; Construction • **Sulawesi Tenggara :** Agriculture, forestry, and fisheries; Mining and excavation; Construction • **Sulewesi Barat**: Agriculture, forestry, and fisheries; Processing; Wholesale and retail trade, car and motorbike repair
		Public	75	46	96	86	3	50	31	109	2	65	563	
Subtotal			671	158	368	592	29	416	67	527	4	405	3237	
LLDikti Region X	Sumatera Barat, Riau, Kepulauan Riau, Jambi	Private	534	80	154	518	26	350	46	352	22	272	2354	• **Sumatera Barat :** Agriculture, forestry, and fisheries; Wholesale and retail trade; Transportation and warehousing • **Jambi**: Agriculture, forestry, and fisheries; Wholesale and retail trade; Mining and excavation • **Riau :** Processing; Agriculture, forestry, and fisheries;Mining and excavation • **Kepulauan Riau:** Processing; Construction; Mining and excavation
		Public	50	39	81	122	4	57	24	130	20	74	601	
Subtotal			584	119	235	640	30	407	70	482	42	346	2955	
LLDikti Region XI	Kalimantan Selatan, Kalimantan Barat, Kalimantan Timur, Kalimantan Tengah,	Private	264	62	124	302	6	224	22	224	4	152	1384	• **Kalimantan Selatan:** Mining and excavation; Agriculture, forestry, and fisheries; Processing • **Kalimantan Timur:** Mining and excavation; Processing; Construction • **Kalimantan Utara:** Mining and excavation; Agriculture, forestry, and fisheries; Construction
		Public	36	34	89	362	6	53	6	113	5	64	768	

Region	Province	Public or Private Higher Ed	Number of Study Program based on Field of Study											Top 3 Sector Industries contributing most to GRDP (Gross Regional Domestic Product)
			STEM				Non-STEM							
			Health science	Mathematics and Natural Sciences	Agriculture	Engineering	Religion Studies	Economics	Humanities	Education	Art	Social science	Total of Study Program	
	Kalimantan Utara													• **Kalimantan Barat, Kalimantan Tengah:** Agriculture, forestry, and fisheries; Processing; Wholesale and retail trade
Subtotal			300	96	213	664	12	277	28	337	9	216	2152	
LLDikti Region XII	Maluku, Maluku Utara	Private	42	16	82	74	10	60	6	124	2	104	520	• **Maluku:** Agriculture, forestry, and fisheries; Government administration and others; Wholesale and retail trade • **Maluku Utara:** Agriculture, forestry, and fisheries; Wholesale and retail trade; Government administration and others
		Public	4	10	47	47	2	13	9	45	0	13	190	
Subtotal			46	26	129	121	12	73	15	169	2	117	710	
LLDikti Region XIII	Aceh	Private	208	18	76	104	2	98	4	184	0	74	768	• **Aceh:** Agriculture, forestry, and fisheries; Wholesale and retail trade; Construction
		Public	30	17	43	70	4	31	1	42	7	27	272	
Subtotal			238	35	119	174	6	129	5	226	7	101	1040	
LLDikti Region XIV	Papua, Papua Barat	Private	26	14	86	146	22	104	6	110	0	134	648	• **Papua:** Mining and excavation; Construction; Agriculture, forestry and fisheries • **Papua Barat:** Processing; Mining and excavation; Construction
		Public	9	12	26	31	1	13	7	38	3	16	156	
Subtotal			35	26	112	177	23	117	13	148	3	150	804	
LLDikti Region XV	Nusa Tenggara TImur	Private	50	30	88	76	10	72	18	240	2	68	654	• **Nusa Tenggara Timur:** Agriculture, forestry and fisheries; Government administration and others; Wholesale and retail trade
		Public	5	8	35	25	1	13	1	27	2	16	133	
Subtotal			55	38	123	101	11	85	19	267	4	84	787	
LLDikti Region XVI	Gorontalo, Sulawesi Tengah, Sulawesi Utara	Private	144	32	116	192	24	144	18	112	2	156	940	• **Gorontalo, Sulawesi Utara:** Agriculture, forestry and fisheries; Wholesale and retail trade; Construction • **Sulawesi Tengah:** Processing; Agriculture, forestry and fisheries; Mining and excavation
		Public	31	25	48	88	4	29	11	104	0	37	377	
Subtotal			175	57	164	280	28	173	29	216	2	193	1317	

Source: Higher Education Statistics (2020), Ministry of Research, Technology and Higher Education of the Republic of Indonesia, and Indonesian Central Statistics Agency (2020)

Figure 1 below also highlights the mismatch between study programs available in Indonesia and the leading industrial sectors in Indonesia (National Development Planning Agency, Republic of Indonesia). An example is the province of Bali, which has great potential to transform its economy. Its natural wealth is complemented by its historical wealth and can be a focal point for regional economic transformation. It would be harmonious if universities in Bali focused on tourism, performing arts, and art and design (non-STEM) to support this economic transformation rather than on information technology or other fields (STEM). Meanwhile, the capital of East Java province is an industrial city supported by some world-class universities. The leading industrial sectors in East Java include the basic chemical, metal, automotive, shipping, and medical equipment industries. Therefore, higher education should focus on engineering (STEM) rather than non-STEM fields to support regional competitive advantage. It would be interesting if local governments considered establishing a Silicon Valley-type initiative focusing on innovation and technology as a priority industry.

The challenge for regional governments is to synergize the potential of existing higher education institutions to accelerate their economic transformation. The National Long-Term Development Plan 2025–2045 (RPJPN) identifies three kinds of transformation—economic, social, and governance—that will lead Indonesia to become a developed country. These three transformations need to be pursued by regional leaders; it is important to realize that local governments do not have all the resources needed to transform their economies. In addition to having world-class universities, the involvement of various actors in the regional economic ecosystem is very important for economic transformation. It is important that these actors cooperate, compete, and complement each other to grow dynamically over time, supported by the talent and technology trained and developed by the region's world-class universities.

The study found that there is a mismatch between the industrial sector and higher education both nationally and regionally (provincially). At the national level, there is a mismatch in the industrial sector that is not supported by the availability of study programs and fields of science. At the regional level, it is known that resources that become regional potential should be supported by study programs, but this is not the case for several industries, such as mining and excavation in Kalimantan and Kepulauan Papua, also found processing industries in several provinces not relevance with study programs. The mismatch suggests that the replacement resources being used that do not support the future needs of Indonesia could be reallocated to allow for the formation of new capabilities so that resources can be used more optimally (Sirmon et al., 2010).

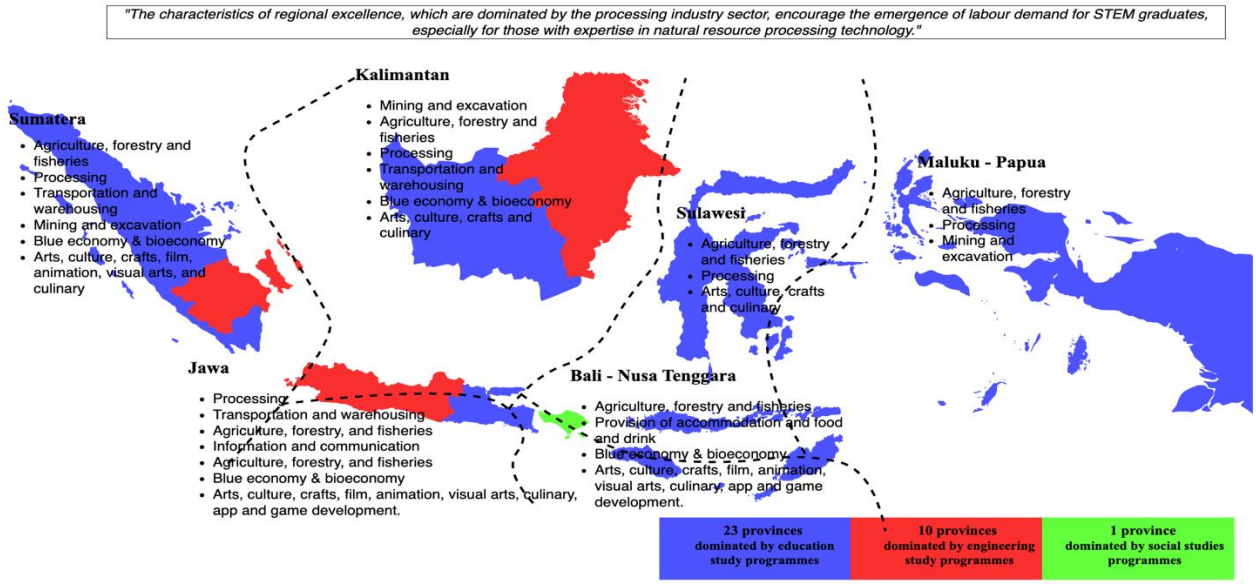

Figure 1. Map of the Distribution of Higher Education Study Programs (Fields of Science) and Top Industrial Sectors Per Region

Source: Presented by National Development Planning Agency, Republic of Indonesia, during a discussion on focus group discussion FGD of the Transformational Leadership and Orchestration of Human Resources (HR) towards *Visi Indonesia Emas 2045* (2024).

Reducing the mismatch between industry and higher education does not only involve the central government but also the regions when it comes to economic transformation (Sukoco, 2024). Especially in Indonesia, which comprises more than 17,000 islands and is home to various cultures, ethnicities, languages, and geographical conditions, each region has different needs, potentials, and challenges. This means it is relevant to consider the alignment of regional potential, in this case, the industrial sector, with the availability of study programs. Related to this, regional governments

need to carry out resource orchestration, especially asset orchestration, to create new capabilities, such as innovation capability. (Sirmon et al., 2010). Progress can be achieved with better quality higher education and innovation capabilities (Lee, 2019).

4.4. Reducing the Gap through Resource Orchestration

Table 2 illustrates a considerable mismatch between the availability of study programs in Indonesia and the sectors that contribute significantly to GDP. The Processing Sector in Indonesia should be supported by the availability of study programs in the STEM field. However, data indicates that study programs in non-STEM fields dominate study programs at both state and private universities in Indonesia. As Sirmon (2011) argues, the resource orchestration that needs to be carried out is adding study programs that are relevant to the needs of the strategic industrial sector and closing or reducing study programs that are less relevant to those needs. Investing in new study programs needs to be supported by lecturers who are experts in the field of study, so hiring them would be one part of resource orchestration. Also, the Education Fund Management Institute (LPDP) of the Republic of Indonesia, one of the largest scholarship-providing institutions in Indonesia, must direct study programs to support this new industry. Scholarship awardees should focus on taking the engineering field of study program instead of education fields at the world's top universities.

This study employs the Resource Orchestration Theory (ROT) proposed by Sirmon et al. (2010) as a theoretical lens to examine the implementation of resource orchestration in the Indonesian context. As part of the Economic Transformation process, human resources must contribute to achieving the *Visi Indonesia Emas* 2045 outcomes. Referring to ROT (Sirmon et al. 2010), this study applies ROT, which consists of several stages. First is search and selection, which is the process of identifying and evaluating resources that have the potential to improve future output or performance. This study identifies mismatches between sectors and study programs, showing the extent to which the knowledge can support the needs of its Industry sector. There is a mismatch in the identification or evaluation; at this stage, it is known that resources in the form of study programs cannot support the needs nationally or regionally. The mismatch serves as the foundation for the formulation of strategic initiatives. Therefore, resource orchestration is needed to reduce the mismatch. After the mismatch is known, selection efforts are needed to determine what fields of science/study programs are following the needs so that the government can initiate what study programs are needed to resolve the mismatch.

Second, the structuring stage includes acquiring, accumulating, and divesting. Acquiring is the stage of getting the resources needed. For this reason, this stage focuses on obtaining the necessary resources related to the fields of science/study programs that are following the needs. For this reason, the government needs to increase the number of lecturers and researchers with the background required by the industry, build laboratories and information systems, prepare new curricula, recruit lecturers and researchers from abroad with international reputations, and encourage the diaspora with STEM qualifications to contribute their expertise to the country's development. Furthermore, accumulating is a stage to ensure that the resources obtained are appropriate; if necessary, the government can move or distribute resources from one region to another in need. Next is divesting, which releases less relevant or inefficient resources. At this stage, efficiency should begin to be carried out on inefficient and low-contributing resources, such as closing study programs that are not relevant to strategic needs and objectives, reducing inefficient and unnecessary research infrastructure, and so on.

Third, the bundling stage refers to integrating resources to form capabilities, this part begins with the merging of previously obtained resources, including lecturers who have been recruited into selected study programs, or connecting lecturers and laboratories, merging relevant study programs, even if necessary university mergers, by adding small adjustments such as improving information systems, improving quality assurance systems, Next, further capability enhancement is carried out such as sending lecturers who have been recruited for doctoral studies either domestically or abroad, increasing teaching competence, increasing research support, increasing research facilities so that their expertise is relevant to increase the capability of the study program (enriching). The next stage is to create new capabilities with unique advantages relevant to future needs, such as establishing new study programs (lecturers, laboratories, curriculum) to strengthen capabilities among existing study programs (pioneering).

Fourth is the leveraging stage; at this stage, various resources, lecturers, curriculum, laboratories, and new and old study programs begin to be utilized and exploited to anticipate the needs of the industrial sector, which begins with the preparation of roadmaps and development plans for various resources (study programs) to ensure the configuration of resources by what is determined (mobilizing). Synchronization is carried out between government institutions and ministries such as the Ministry of Education and Culture, which is related to academics, and the Ministry of Manpower, which is related to graduates, provincial governments, and local governments, which is related to the budget. This is to ensure the sustainability of the capabilities of the study program that has been improved (coordinating); then, by utilizing the advantages of its resources and entrepreneurial strategies, the government releases study programs in any region that needs them (deploying). Based on this process, it is expected that there will be an increase in study programs that are not only following current needs but also the needs of human resources or graduates in the future.

5. Conclusions

Strategies for economic transformation vary among countries. However, one standard key to success is the quality of a nation's human resources. Indonesia's human capital quality is below the global average and remains lower than that of higher middle-income countries. Therefore, Indonesia must focus on building and upgrading its human capacity, which will serve as the foundation for transforming the country into a developed nation in the 21st century.

The enhancement of human resources is a cornerstone of *Visi Indonesia Emas 2045*. Human resources will facilitate the production of technological products with high added value, resulting in per capita income levels that are on par with those of developed countries. Human resources represent the future of Indonesia, and the country's demographic dividend, or its high proportion of young people, may help it achieve its aims. One of the most important representations is university graduates, where the extent to which graduates' competencies are appropriate can be seen from the availability of study programs so that the need for human capital is known for the current and future.

Considering the rationale, this study seeks to address RQ: Is Indonesia's higher education provision in line with its human capital needs for the future? This was addressed through qualitative research utilizing a secondary data analysis. The findings indicate a mismatch between the skills and expertise of Indonesian human resources (higher education field of study related to the study program), the requirements of the Indonesian market (The leading industrial sector's GDP), and the country's geographical context. Analyzing Indonesia's human resources situation reveals a national and regional mismatch. This suggests that Indonesia has not yet fulfilled the criteria for being classified as a developed country (Lee, 2019).

Learning from Japan, South Korea, and China's success stories in escaping the middle-income trap, Indonesia must devise a comprehensive development strategy and feasible roadmap that will determine the country's future priority and strategic sectors as engines of growth, paving the way for economic transformation. Furthermore, inherent to this effort, improving the national educational system, especially through higher education, should be oriented towards strengthening these prioritized sectors.

Indonesia can then initiate and implement meaningful economic structural changes, especially to transition from natural resource to human resource-oriented development, and move workers and resources from lower to higher productivity areas, using knowledge-based technology. This will accelerate Indonesia's strategy to develop pilot areas or districts, encouraging the growth of the middle-class and creative societies, leading again to a higher per capita income and creating a backbone for the state's sustainable economic transformation. Critical to such a huge undertaking is the presence of transformational leadership, as well as the effective orchestration of human resources. Through higher education study programs, education can be used as one concrete strategy to reduce unemployment and provide opportunities to build careers, prosperity, and dignity. This will allow Indonesia to seize the opportunity to transform itself into a developed nation, realizing *Visi Indonesia Emas 2045*.

6. Implications

6.1. Academic Implications

This research contributes to the existing body of literature on resource orchestration theory (ROT) by exploring its applicability to orchestrating a country's human resources. While previous studies have employed ROT in organizational settings (e.g., Carton & Parigot, 2024; Attah-Boakye et al., 2023; Wendt et al., 2022; Carnes et al., 2017), this study extends its implementation to a country-level analysis.

Moreover, ROT typically employs surveys (of the perceptions of organizational members), which are susceptible to bias (Fisher 1993). This study, however, employs a distinct and more comprehensive approach, namely, analysis of secondary data (e.g., from the Indonesia Center Statistic Agency, Higher Education Statistics).

6.2. Policy Implications

Higher education institutions can enhance the effectiveness of their resource orchestration by discontinuing programs no longer aligned with the evolving needs of industry and by establishing future-oriented programs (Sukoco, 2021). These programs should not be driven by immediate popularity but rather by their potential to meet future industry demands. It is, therefore, important for the government to evaluate the proportion of study programs and students, including the potential contribution of graduates in the future (Sukoco, 2023). This is because graduates will be needed in the future in areas that are not currently popular.

The government should close study programs that are not in line with market needs, which is a strategic step to ensure that higher education is relevant to industry needs, both in the short and long term. If graduates are not relevant to the market, there is a risk that unemployment will increase or the graduates will work outside their field of expertise, which can harm the economy (Manacorda & Petrongolo, 1999). Also, by closing ineffective study programs, universities can allocate resources to those instead that have a more significant beneficial impact on regional economies in the future. Programs that include a range of scientific disciplines will contribute to regional economies and produce graduates who are skilled in areas of science that have the potential to attract investment. Such labor is more productive and efficient, reducing production costs, increasing output, reducing unemployment, and boosting regional economic growth.

The advancement of a country is contingent upon the extent to which knowledge plays a role in its economy. A knowledge-based economy necessitates the availability of knowledge workers or businesspeople who serve as catalysts of change (Suhariadi, 2023; Suhandiah, 2022). Consequently, higher education institutions must offer study programs that align with the market's demands (i.e., market-driven) while considering the potential for current graduates to become obsolete within 5–20-year years. It is understandable that a nation that was advanced two decades ago now lags because the competencies of its higher education graduates are no longer relevant. In the future, higher education with high-added value will be needed (i.e., driving the market). The greater the knowledge applied to the more products (either goods or services), the greater the complexity of a country's economy. These products will have high added value, increasing per capita income. This underscores the growing importance of a knowledge-based economy for a country.

Education is a long-term investment for a nation. For a country to become developed, it must provide quality higher education capable of producing innovation (Lee, 2019). In order to achieve this, it is necessary to select, sort, and modify existing study program curricula or even discontinue them if they are less relevant. What is popular now may not be relevant for graduates in the future due to market-driven forces. It is time for the government to evaluate the proportion of study programs and students, including the potential contribution of graduates in the future. To provide a long-term vision for education, the government must determine what strategic industries will be developed. The government and HEI managers must establish future-oriented study programs to do this. Upskilling existing teaching staff and recruiting new teachers must adhere to market-driven strategies. Meanwhile, Long-term funding commitments will provide certainty and sustainability, ensuring the nation's competitiveness remains strong. It is crucial for Indonesia to adopt both market-driven and market-driving strategies for higher education. Human resources, as the nation's most strategic resource, are pivotal to enhancing the complexity of the Indonesian economy and achieving progress by 2045.

7. Limitation and Future Research Direction

This study has several limitations, which future research may consider to improve its results. First, the study used only secondary data, with the main objective being to identify mismatches between the industrial sector and higher education. Future research can continue to explore mismatches and prioritize which industries are suitable at both the national and provincial levels using primary data and various research methods such as Delphi and AHP. The results of the mismatch analysis indicate a need for further study to identify and compile the nation's priority industries. Such a study would facilitate the development of relevant human resources and innovation capabilities, thus supporting the achievement of *Visi Indonesia Emas 2045*.

Secondly, although the data used in this study is quite detailed, especially data related to students, graduates, study programs, and fields of science, the study was not able to deepen the data at the provincial level; e.g., one region has potential in the mining and quarrying sector, but the available study program information is general, namely only related to engineering studies, and not specifically information related to mining and excavation study programs. Future research can consider examining this by extracting and using more specific and detailed data.

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Author Contribution

Author 1: Conceptualization, writing original draft, formal analysis, investigation, editing draft, revision editing.
Author 2: Conceptualization, methodology, data curation, review, formal analysis, editing draft, revision editing.
Author 3: Conceptualization, methodology, data curation, review, formal analysis, editing draft, revision editing.
Author 4: Conceptualization, review, and supervision.

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Conflict of Interest

The authors have no financial or non-financial conflicts of interest that need to be disclosed in this study

Appendix

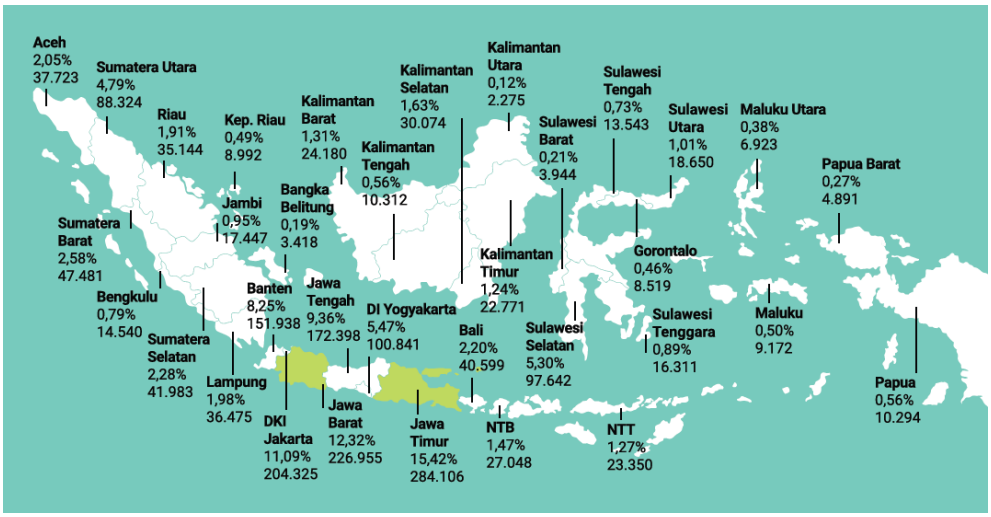

Figure 2. Number of Graduates by Provinces in Indonesia

Source: Higher Education Statistics (2020), Ministry of Research, Technology and Higher Education of the Republic of Indonesia

Figure 3. Domination of New Entrance Students in every Island in Indonesia

Source: Higher Education Statistics (2020), Ministry of Research, Technology and Higher Education of the Republic of Indonesia

Figure 4. Study Program Distribution in Provinces in Indonesia
Source: Higher Education Statistics (2020), Ministry of Research, Technology and Higher Education of the Republic of Indonesia

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